Magnetic Rotation in ^{110}Cd

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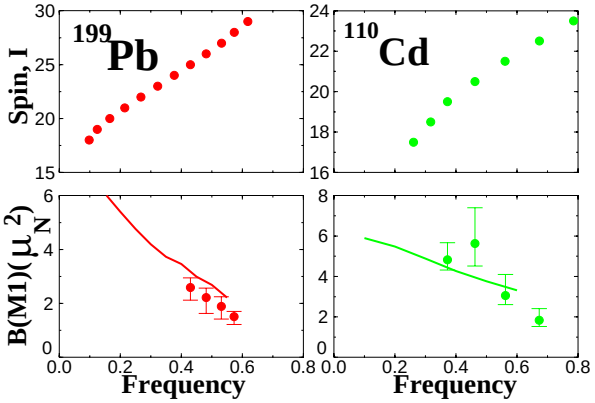
Regular cascades of magnetic dipole (M1) transitions have been observed in several nuclei of the A$\sim$110 Cd–Sn region. They have properties very similar to M1 cascades found in the Pb isotopes [1]: 1) the structures closely follow the linear behavior of spin, I, as a function of ω typical for rotational bands despite low deformations; 2) the levels are linked by strong M1 transitions with weak E2 crossover transitions (typical B(M1)/B(E2) ratios $\geq$20–40 $(\mu_N/\mathrm{eb})^2$); 3) the ratio $\Im^{(2)}$/B(E2) is roughly an order of magnitude larger than that for normal–deformed bands. These properties suggest that the bands may be examples of 'magnetic rotation'. Unlike the M1 bands in the Pb isotopes, which are based on slightly oblate shapes, the structures in the Cd–Sn region are thought to be based on slightly prolate configurations involving high-Ω $g_{9/2}$ proton holes coupled to low–Ω $h_{11/2}$ neutrons. The component angular momentum vectors from the proton and neutron configurations point in different directions giving rise to a large magnetic dipole. To generate higher angular momentum states the component proton and neutron vectors align ('the shears mechanism') and this behavior results in the reduced transition probability, B(M1), changing characteristically along the band. This can be tested experimentally by estimating the lifetimes of states in the bands using Doppler Shift Attenuation (DSA) techniques.

We have performed a high precision DSA measurement aimed at extracting state lifetimes for structures in ^{110}Cd. High–spin states in this nucleus were populated using the ^{96}Zr(^{18}O,4n) reaction at a beam energy of 75 MeV. The target was a 0.6 mg/cm^2 ^{96}Zr foil on a Pb backing to slow and stop the recoils. Gamma rays were detected with the Gammasphere array. Lifetimes were extracted by fitting the observed Doppler broadened lineshapes. In particular, B(M1) values could be deduced from the state lifetimes of a strong M1 band in this nucleus. In the figure, the properties of this band are compared with those of a similar structure seen in ^{199}Pb. The top part of the figure shows the linear behavior of the spin, I, as a function of frequency which is characteristic of rotational bands. The B(M1)'s for both sequences show a characteristic drop which can only be explained by the shears mechanism. The results on this M1 band in ^{110}Cd are the first proof of magnetic rotation outside of the Pb region.



References

[1] R.M.Clark et al., Phys. Rev. Lett 78 (1997) 1868